A comparative multilevel investigation of the socioeconomic determinants of knowledge about HIV/AIDS in Africa

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PREFACE

I wish to thank my parents for their immense and unwavering support and encouragement throughout all my years of studying. I would also like to thank my supervisor, Professor Øystein Kravdal at the University of Oslo, not only for his insights, support and feedback, but also for sparking my initial interest in the subject of demography more generally. And finally to all my dear friends for their invaluable support over the last two years in Norway.

Any misunderstandings, misprints and mistakes in this study are, of course, my responsibility alone.

1. INTRODUCTION

There have been major achievements in the advancement of access to treatment and greater awareness about HIV/AIDS in Sub-Saharan Africa over the past two decades. However, statistics still indicate alarming differentials in what people know about the disease in this part of the world that has been worst hit by AIDS and where the main mode of infection is through heterosexual sex.

Lack of knowledge in large groups of the population is of course a major concern given the current incurable nature of the disease. Prevention remains the single biggest weapon in the fight against further spread of the epidemic and having a sufficient level of accurate knowledge is key to achieving sustainable success through prevention. In fact, there has been a marked shift in policy initiatives and spending by NGO's and governments over the lifetime of the epidemic from that of a treatment-based approach to a more holistic approach, combining treatment and education about risk-reducing behaviour, especially condom use, to prevent further spread. This was in recognition of the importance and current lack of AIDS education across populations in developing countries, where it has been estimated that only about one in four people received AIDS education (UK Parliamentary Report, 2003.) Countries such as Uganda, Senegal and Botswana are examples where significant results have been achieved in reduction and/or maintenance of infection rates as a consequence of, combined with treatment programs, strong focus on national school and community-based AIDS education initiatives (UK Parliamentary Report, 2003.)

Research has shown that women tend to be less knowledgeable about HIV/AIDS than men, and it is also widely accepted that an individual's own education, personal wealth and other individual-specific demographic characteristics have an influence on knowledge about infectious diseases and health in general. However, it seems likely that social network factors also play a pertinent role in improving awareness and understanding.

Therefore, studies about HIV knowledge that have only considered the effects of individual level factors neglect to account for possible important correlations between individual and community level factors that may influence knowledge, as well as the possible implications of social networks and knowledge diffusion across different levels of aggregation. As such, there may be reason for concern about upward bias of the reported effects of individual factors in studies which ignore the possible effects of community levels variables. Quoting Wade (1970) from her research about the determinants of health knowledge, *"Other things are seldom equal, so we must try to identify other variables that enter into the pattern of building public knowledge."*

The ambition of this study is to examine the influence that individual and community-level education and wealth have for shaping an individual woman's knowledge about HIV/AIDS transmission and prevention. DHS (Demographic Health Surveys) data taken from a sample of women of child-bearing age from 21 Sub-Saharan countries are used, and linear regression models are estimated. The community variables refer to either the census enumeration area where the woman lives or the province.

Various models have also been estimated to compare whether (and how) the impacts observed for HIV knowledge (in response to an adjustment in certain individual and community factors) may differ across individuals with different previous education.

Although this paper focuses on determinants of HIV knowledge, any analysis which aims to contribute to the explanation for differences in what people know, in the context of HIV/AIDS, would not be quite complete without at least making some allowance for differences in HIV prevalence levels. I have therefore also estimated separate models for individuals based on these country-level differences.

In this way, we hope to build a better understanding of the socio-economic differentials in level of understanding about the disease in sub-Saharan Africa.

2. THEORY, PREVIOUS RESEARCH AND BACKGROUND

2.1. THEORY AND PREVIOUS RESEARCH

Existing literature on HIV/AIDS knowledge in Africa has primarily focused on the relationship between knowledge and reported sexual behaviour patterns (Bernardi, 2002.) Evidence from such studies have highlighted significant deviations between sexual behaviours and individual levels of HIV-specific knowledge, where despite widespread reported awareness of the disease in many parts of the continent, there is still often an alarming reluctance in adopting preventative sexual behaviour (Bernardi, 2002.) Fertility/family planning and infectious disease prevention studies have long recognised the significant effects of knowledge in cultivating health enhancing behaviours via different mechanisms. However, there are fewer studies about the determinants of HIV-related knowledge, especially with regards to the role of community-level variables.

That said, in recognition of the need for a better understanding of these determinants and the mechanisms through which they operate for influencing knowledge about HIV, a few pioneering studies have more recently been undertaken in this area and have begun to shed some light on the topic (see Stephenson 2009; Burgoyne et al., 2008; Glick et al., 2008; Glick.P, 2007.) Reviewing the insights from these and, where applicable, drawing on similar mechanisms identified as determinants of health knowledge from earlier studies (Burgoyne et al., 2008; Gwatkin et al., 1999; Bundy et al., 2008; London et al., 2000; Marmot et al., 2006; Mishra et al., 2007) a number of important factors were identified. Below I elaborate on some of the most important causal channels identified that education and wealth operates through to influence health knowledge in order to build a better understanding about how education may influence knowledge specifically about HIV.

The importance of education as a determinant of knowledge is well documented in many previous studies. For example, an extensive report published in 1970, which reviewed health trends in the US over a period of nearly 20 years (and included a host of possible determinants), found that education was such a powerful indicator of health knowledge that it alone could predict as much as all other demographic variables evaluated (Wade, 1970). Despite significant developments in women's rights and education since then, much of the societal conditions which prevailed in the US at the time of that report are still current realities faced by women in many developing countries today (and in some countries possibly even worse.)

More recently, an extensive number of empirical studies have continued to frequently confirm the strong correlation between education and health outcomes (even after controlling for differences in incomes), encouraging researchers to further investigate the mechanisms behind this correlation (see for example Feinstein et al., 2006.) For example, the results from one of, if not *the* most comprehensive cross-sectional analysis of trends in HIV knowledge in Africa (that I am aware of), Glick & Sahn (2007) found that education had statistically significant positive impacts on individual reported HIV knowledge for men and women across all of six African countries they examined by comparing results from survey data over a period of three-six years. In a later report using survey data in Madagascar, one of the same authors (see Glick et al. 2009) also indicates significant knowledge benefits of formal schooling in that country. He estimates that women with four years of secondary education are about 2.5 times as likely as uneducated women to know about HIV prevention methods.

However although the effects of education are often viewed as one of, if not *the*, single most dominating element in determining health knowledge, it is by no means the only factor and there are many other important influences that need to be explored further which may have strong positive implications for knowledge and HIV infection outcomes.

Education is also influenced by a number of social and structural factors at the individual and community level and as such, it may be that the effects of education for HIV knowledge are considerably weaker when these are taken into account. In this chapter I attempt to explain the association between higher levels of education and personal wealth as well as highlighting the independent effects of each in determining knowledge. In addition, using the mechanisms from previous studies which have often indicated a clear relationship between where people live and their knowledge about health, the effects of community level education and wealth measures are discussed below.

2.2. FACTORS CONTRIBUTING TO HIV KNOWLEDGE

2.2.1. INDIVIDUAL FACTORS

i. Education

Education and schooling is assumed to; (i.) improve literacy which enables women to read and understand printed AIDS (and other STD[1]) specific health material, increasing the efficiency of HIV awareness campaigns. In a US based study, Wade (1970) found that people whose main source of knowledge about health came from printed media were observed to have better and more complete information about health than those whose main sources were from broadcast media (TV.) Similarly, in an assessment of the impacts of HIV prevention campaigns in Uganda over a 12 year period, de Walque (2007) provides robust empirical evidence indicating that information campaigns in the country were significantly more effective among the educated, as they were found to be most responsive to the information. This may be because in addition to literacy, by (ii.) exposing individuals to learning new factual concepts & ideas, formal education also encourages a more cognitive and holistic approach to assessing health risks and subsequent outcomes by developing a woman's intellectual reasoning and evaluation capacities and therefore improving her ability to process health related information.

[1] Sexually Transmitted Diseases

More educated women may thus use the skills gained through education in order to weigh-up and compare scientifically-based information acquired (via formal sources) with those gained from other more informal, traditional and social messages. This has been confirmed by a number of empirical studies which find that although individuals may simultaneously hold factual information and inaccurate beliefs about HIV, increased education levels reduce the likelihood of holding false beliefs (see Bernardi, 2002 and Londona, 2000.) A study in Botswana highlighted this effect of education and estimated that those with no formal education were as much as ten times more likely to harbour misconceptions about HIV transmission and prevention than those with some tertiary education (Letamo, 2007.) Having a better understanding about the disease makes educated women better able to gauge the true impacts of their sexual behaviours and subsequent health outcomes. They therefore tend to have more accurate self perceptions of being at risk of infection, an important determinant of motivation to acquire sufficient information to protect themselves (Bernardi, 2002.)

Also, besides having a more efficient interpretation of information about HIV/AIDS, the costs of acquiring such information may be lower for those who are better educated (and/or literate) than those with no formal schooling because it is likely to be transmitted through channels they may already use for example by reading the newspaper (Glick, 2008.)

Having been exposed to formal schooling methods is also likely to introduce women to ways in which to better access *further* HIV information above and beyond what is taught in schools by teaching them (iii.) how to gather, access and evaluate information as well as generally strengthening Western values. Improved Information seeking behaviour may also be a result of the potential self-esteem and self-efficacy benefits education creates. Women may feel more in charge of taking responsibility and initiative to seek *further* information from relevant sources than uneducated women who rely more heavily on informal and traditional sources. Evidence has shown that individuals with formal education are more likely to continue to seek further health information beyond what they learn in school later on in life (Wade, 1970.)

So even if education is not tailored to convey HIV specific information, formal education positively influences motivation, skills and consciousness for women to acquire *additional* information from reliable sources outside of the classroom. In a comprehensive review of trends in health knowledge in the US (see Wade, 1970) it was found that individuals who had not completed formal education appeared to have a decreased level of health knowledge with the passing of time, in comparison to those who had completed high school, who appeared to gain further knowledge with time. The author attributed this to the possibility that those who had not completed school had not acquired sufficient skills or interest to maintain and further their health knowledge in comparison to the fully educated group.

Some economists have also argued that those who have already invested more time and resources in education may place heavier weighting on future outcomes (see Becker, 1993.) Glick et al. (2008) extend this notion by arguing that since these individuals have higher projected future earnings and consumption possibilities, they may also have greater incentives to look after their health by gathering information about HIV prevention. This argument may be somewhat far-fetched and there are no empirical results (to my knowledge) to indicate that this theory applies in practice, however for the possible reasons outlined above, people who have some level of education are often motivated for various reasons to acquire and ensure better understanding of factual information about health and diseases.

In addition to being better acquainted with different/new ways of learning and information acquisition, there is also reason to believe that by attending formal education, schooling may (iv.) introduce different human interaction patterns and socialization otherwise not frequently practiced in certain cultures among women who do not attend school. This may be particularly relevant in African societies where individuals are often segregated on the basis of ethnicity, tribe, age, gender and social status differences. In this way, education may facilitate an important medium for learning about HIV/AIDS; through dialog and casual communication.

It offers women the opportunity to interact with other students outside of their immediate family environment and to share experiences and knowledge which may be a way to break through traditional (African) taboos about discussing topics of a sexual nature.

Educated women also have (v.) improved opportunities to find more skilled and better paid jobs, the key link between education and individual wealth. Literacy and the other skills gained from education may alter a woman's income generating potential and her ability to work outside of the house. These economic advantages may further shape her knowledge through the mechanisms in which wealth operates, above and beyond her educational attainment, as discussed in detail below.

ii. Wealth

Education and wealth clearly influence each other mutually (or are determined together); just as having better education may lead to the possibility of finding a more skilled and well paid job, education may reflect parental wealth (Berkman et al., 2000.) Both may have significant independent effects on knowledge. Stated differently, women with greater wealth, net of other individual characteristics, may have better knowledge than those who do not. This is because having access to and control over greater economic resources means that the person is (i.) able to afford a number of material and non-material (social) benefits which influence HIV knowledge, often closing the gap between what individuals would theoretically be willing to pay for information and services and what they are realistically able to afford. Those with higher disposable incomes will thus be more willing to spend on accessing better knowledge for themselves, adding to possible benefits of being educated. Again, as with education, higher incomes may facilitate easier access to information about HIV/AIDS, especially in developing country contexts. Besides access to formal schooling and health care facilities, wealthier individuals may find it easier to access factual information that is disseminated through the mass media. In this study where we use ownership of a number of household possessions to provide some indication of wealth, those who for example have access to a radio or television may be at an advantage to individuals from poorer households.

Empirical studies have, for over more than forty years now, shown that income is a major determinant of *health seeking behaviour.* Given the obvious link between knowledge and behaviour, why then is it not plausible to believe that increased income leads to more health *knowledge* seeking *abilities* as well? More specifically, by earning her own income, a woman is able to access a variety of and better quality health care & educational services (in her immediate area or further afield), where she is able to gain information about HIV/AIDS. Previous empirical work confirms that relatively wealthy individuals tend to have a greater *ability to look for* and receive treatment in the case of any illness more generally, which is predicted to be beneficial for the prevention and treatment of all sexually transmitted diseases including HIV/AIDS (Kirunga et al., 1997.)

Earlier studies have also speculated that information seeking abilities (and behaviours) may differ between those with different income levels because poor people may tend to discount future consumption more than wealthier people and as such may invest less time or resources in gathering health information, thus making them less receptive to messages about HIV (Glick et al., 2008.)

Having relatively higher levels of personal wealth is also (ii.) associated with living in more urban areas and having greater opportunities for mobilisation which may increase individual health knowledge. This may be because, among other things, wages in urban areas tend to be higher than those in rural areas, and individuals are also likely to have greater accessibility to health and education services in these areas. This is discussed in more detail below. A Ugandan study found that individuals who live in urban areas and/or have greater exposure to occupations associated with more travel and higher wealth, have as a result, better access to information about health hazards such as HIV and thus tended to have better knowledge and use of protection than poorer people in more rural areas (Kirunga et al., 1997.)

Wealth may also, just as having better education, (iv.) influence a woman's level of HIV knowledge via the diffusion of knowledge through social networks. Personal wealth, to a large extent in many countries, determines the social position of individuals and so those who are relatively wealthy are less likely to be socially excluded from the community and may therefore also be more likely to learn from others. Especially through interaction with the socially most advantaged in the community which may reduce the likelihood of holding certain misconceptions about HIV.

For women who earn their own incomes and have the (v.) freedom to work outside of the house, this may also increase the frequency in which women interact with others she works with who have better and/or different knowledge and experiences about HIV than her own.

2.2.2. COMMUNITY-LEVEL FACTORS

As already alluded to, aggregate measures of community-level socioeconomic variables probably also have significant independent effects on an individual's knowledge above and beyond the benefits afforded by higher individual-specific education and wealth levels. In general communities where, on average a higher proportion of women are educated and literate, are likely to (i.) foster a general culture of better knowledge, acceptance and reinforcement of correct prevention mechanisms amongst individuals (Stephenson, 2009.) So even those who themselves are not educated and economically fortunate are likely to benefit from living in such communities through what is known as social learning mechanisms. To be more specific, certain beliefs, cultures and principles related to HIV transmission are often shared and well entrenched amongst people who live in the same local (or larger) community. In the absence of quality and easily available education and formal information sources, knowledge from others may be a crucial source of information, making women particularly vulnerable to false beliefs and norms held by others in her community.

Bernardi (2002) found that, unsurprisingly, the degree to which women felt of being at risk of HIV infection, controlling for her their personal traits, is very much determined by the prevailing circumstances and social customs within her area of residence. These include the extent to which other members in her community feel of being at risk of infection, which is often based on misconceptions and incorrect information (Bernardi, 2002.)

Regardless of their own financial means, living in a wealthier, and therefore also often a more urban area, is also likely to improve a woman's HIV knowledge because of generally easier access to information via (ii.) accessibility to better quality health and educational institutions and better paying job opportunities. In other words, even poor urban residents are often regarded as having greater access to information than the rural poor. These areas may also offer better access to more developed communication and transport infrastructure such as the presence of major national roads and as such may allow for more efficient dissemination of information about HIV/AIDS (Glick et al., 2008.) Because of the high density of social networks and channels for public messages, urban areas may also allow for more efficient and rapid spread of information. In addition, urban cities or trading centres may also have particularly intense AIDS awareness campaigns than in rural parts given that urban areas and residents are often viewed as those at greatest risk of infection in many countries.

Studies have found that an increase in distance to health clinics (as may often be the case for rural residents) significantly *reduces* a woman's knowledge about HIV prevention (see Glick et al., 2008.) Because rural residents, by comparison to those living in urban areas, are often reliant on relatively fewer alternative sources of information, this may make them more dependent on the education and wealth of others in their area (as discussed briefly before.) Similarly, Aviles et al. (2009) found that individuals living in communities where health services (hospitals and primary care clinics) were present, net of individual characteristics, had higher average measures of malaria knowledge in their Honduras-based study.

Likewise, using data from a sample of households surveyed in Ghana, Andrzejewski et al. (2009) found that, the presence of a regular commercial market and having migrant workers living in a community, had significant positive effects on individual child and general health knowledge for others who live in these areas, regardless of their individual characteristics. This the authors attributed to the role these factors play in creating a more heterogeneous community with greater diversity of knowledge and wider social networks. In other words, members of such communities have greater opportunities to interact with (and learn from) individuals from their own and other areas in a casual setting at these markets, than those who don't have a regular market in their community. These sorts of casual conversations are especially relevant and important for individual knowledge about HIV/AIDS and other sexually transmitted diseases where the consequences of blame and stigmatization related to HIV not only creates an environment where misconceptions are likely to persist but studies have also suggested that the fear of being isolated also prevents HIV-positive people from disclosing their status or making use of services (Mhloyi, 1992.)

On the other hand, it is also possible that, given the woman's own resources, living in a community with many well-educated and rich people means that she may be in a low *relative* position than she would otherwise be which may have a detrimental impact for her knowledge about HIV. She may be isolated both socially and excluded from other services she is not able to afford. This is of course then prevents individuals from acquiring accurate knowledge as discussed above.

Through the different mechanisms discussed above, it is clear that individual education and wealth have the potential to exert significant influence on individual knowledge and as such, educated (and wealthy) women are expected (and in many instances have been shown to) have generally better awareness and understanding of the consequences of and methods to prevent HIV/AIDS.

There are also many plausible reasons to suggest that the effects of changes in individual and/or community level education (and wealth) are likely to have more or less pronounced consequences for women's knowledge about HIV between women with different *prior* levels of education (and wealth.) In other words, changes in education (for example as a result of education expansion policies implemented in a region or country) are likely have stronger consequences for knowledge held by women who themselves have little or no education in comparison to the effects of an identical change among those who already have some level of education.

This is because women who have relatively low levels of education to begin with are presumed to be starting from a low (HIV) knowledge base. Even marginal improvements in education are therefore likely to, through literacy and essential basic skills learned in the foundation years of schooling, add significantly more knowledge relative to what she knew before for a less educated woman than an individual with formal education. In comparison to those who have attended some years of formal schooling, and perhaps have a better variety of alternative sources of HIV information, women who have not had equal education opportunities may be relatively more reliant on information learned through interacting with others who are better educated and who know more about the disease (as mentioned earlier.) Individual awareness about HIV/AIDS is therefore likely to also be more sensitive to a change in the average community level of education for those who themselves are less educated.

In contrast however, those with higher levels of education are expected to have already acquired some degree of knowledge about HIV/AIDS (via the various mechanisms discussed above) and are assumed to have access to more sources of health information then the less educated and thus the marginal effects of education beyond their current level will help to improve HIV knowledge by building a better understanding of *already established* knowledge held, but will be less pronounced than for the less educated.

It is also reasonable to expect that an increase in the average education level for others in her community may also further strengthen knowledge of an educated woman, perhaps for slightly different reasons than for less educated women. It may be that, she gains a more in-depth understanding and comprehension about transmission and prevention above her current awareness of the disease by having more other educated women to share ideas and experiences with.

For these reasons, those with lower levels of education are likely to exhibit a steeper knowledge/education gradient in response to additional improvements in their own education and for an increase in community level education. Glick et al. (2009) confirm this in their findings from Madagascar where they found significantly larger incremental impact of primary education on HIV prevention knowledge versus post-primary education.

3. DATA AND METHOD

3.1. DATA

The data used in this investigation was taken from the Demographic and Health Surveys (DHS) undertaken in 21 African countries (Benin, Cameroon, Chad, Cot d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia, and Zimbabwe) and includes a sample of 224 781 women between the ages of 15-49 years.

It is clear from the summary statistics below (see Table 1) that the distribution of ages for the women in this sample is fairly even indicating that no age group is particularly likely to skew the result significantly in the following regressions estimated. It is worth noting also that almost 45% of those in the sample are 25 years or younger. This age group is the group identified in most countries as being at highest risk of contracting HIV through heterosexual sex.

Table 1 Age Distribution

Age Distribution				
Age	Frequency	Percent	Cumulative Frequency	Cumulative Percent
15	6592	2,93 %	6592	2,93 %
16	9756	4,34 %	16348	7,27 %
17	9022	4,01 %	25370	11,29 %
18	10686	4,75 %	36056	16,04 %
19	8901	3,96 %	44957	20,00 %
20	11248	5,00 %	56205	25,00 %
21	8110	3,61 %	64315	28,61 %
22	8770	3,90 %	73085	32,51 %
23	8167	3,63 %	81252	36,15 %
24	7513	3,34 %	88765	39,49 %
25	10723	4,77 %	99488	44,26 %
26	8122	3,61 %	107610	47,87 %
27	7140	3,18 %	114750	51,05 %
28	8167	3,63 %	122917	54,68 %
29	6219	2,77 %	129136	57,45 %
30	9496	4,22 %	138632	61,67 %
31	5844	2,60 %	144476	64,27 %
32	5944	2,64 %	150420	66,92 %
33	5247	2,33 %	155667	69,25 %
34	4724	2,10 %	160391	71,35 %
35	7614	3,39 %	168005	74,74 %
36	5317	2,37 %	173322	77,11 %
37	4259	1,89 %	177581	79,00 %
38	4958	2,21 %	182539	81,21 %
39	3807	1,69 %	186346	82,90 %
40	6349	2,82 %	192695	85,73 %
41	3896	1,73 %	196591	87,46 %
42	3694	1,64 %	200285	89,10 %
43	3525	1,57 %	203810	90,67 %
44	2920	1,30 %	206730	91,97 %
45	4731	2,10 %	211461	94,07 %
46	3635	1,62 %	215096	95,69 %
47	2806	1,25 %	217902	96,94 %
48	3289	1,46 %	221191	98,40 %
49	2930	1,30 %	224121	99,71 %
50	660	0,29 %	224781	100,00 %

Table 2 Education Distribution

Educati on Distributi on				
Educati on	Frequency	Percent	Cumulati ve Frequency	Cumulati ve Percent
0	85081	37,85 %	85081	37,85 %
1	3741	1,66 %	88822	39,51 %
2	6873	3,06 %	95695	42,57 %
3	8473	3,77 %	104168	46,34 %
4	10049	4,47 %	114217	50,81 %
5	14765	6,57 %	128982	57,38 %
6	15925	7,08 %	144907	64,47 %
7	17496	7,78 %	162403	72,25 %
8	12182	5,42 %	174585	77,67 %
9	13255	5,90 %	187840	83,57 %
10	10568	4,70 %	198408	88,27 %
11	5189	2,31 %	203597	90,58 %
12	12439	5,53 %	216036	96,11 %
13	1833	0,82 %	217869	96,93 %
14	1908	0,85 %	219777	97,77 %
15	2492	1,11 %	222269	98,88 %
16	1598	0,71 %	223867	99,59 %
17	592	0,26 %	224459	99,86 %
18	197	0,09 %	224656	99,94 %
19	71	0,03 %	224727	99,98 %
20	54	0,02 %	224781	100,00 %

Table 3 Urbanisation Proportions

Urbanisati on Proporti ons				
Urbanisati on	Frequency	Percent	Cumulati ve Frequency	Cumulati ve Percent
0	138919	61,80 %	138919	61,80 %
1	85862	38,20 %	224781	100,00 %

I have used data taken from the most recent available DHS in each country. The year of survey used and sample size for each country are shown in table 4 below.

Table 4 Country Distribution and sample size

Survey Samplesize	
Country & Year of Survey	Sample size
Benin (2006)	16539
Cameroon (2004)	10358
Chad (2004)	4889
Cot d'Ivoire (2005)	8434
Ethiopia(2005)	12353
Ghana(2008)	10327
Guinea (2005)	7612
Kenya (2003)	6750
Madagascar (2004)	5985
Malawi (2004)	11004
Mali(2006)	11813
Mozambique(2003)	8428
Namibia(2007)	9619
Niger(2006)	7700
Nigeria(2008)	33413
Rwanda(2005)	11260
Senegal(2005)	14002
Tanzania (2005)	10198
Uganda(2006)	8416
Zambia (2007)	7049
Zimbabwe (2006)	8632

Since the early 1980's, DHS have been conducted across most developing countries with the aim of collecting and compiling accurate, high quality data in the areas of education, fertility, family planning, maternal and child health, woman's autonomy, malaria, nutrition, and since the late 1980's, HIV and AIDS.

Through both the nationally conducted DHS and the more recently developed AIDS Indicator Survey, DHS have compiled data including not only standard HIV measures such as prevalence rates but also more detailed information regarding knowledge about prevention methods, attitudes towards those with the disease, beliefs about transmission and behaviour to provide accurate nationally representative figures.

In many countries these indicators have been included in multiple surveys conducted periodically and thus allow for trend analysis and comparison over time and across countries.

The DHS use a stratified two-stage cluster design technique for the surveys (as is common practice in population-based surveys.) Information is collected from selected census enumeration areas (clusters) to be representative of the different provinces, both rural and urban, in surveyed countries. The data used in this study includes 100-521 sampled enumeration areas (census tracks) in each of the 21 countries which include small villages/settlements and small towns that may be part of a larger town or city.

Through two types of questionnaires used, women of reproductive age (15-49) are interviewed in about one in ten households from these areas. The data include information about the woman's level of education, whether the area she lives in is rural or urban, her age and various other factors such as whether she is married, and indicators of wealth and religion at the time of interview.

The separate questionnaires designed to specifically evaluate the respondent's knowledge, attitudes and behaviour regarding HIV/AIDS include questions about ways in which infection is transmitted, methods of prevention, and self perceived risks of acquiring the disease.

3.2. METHODOLOGY

I have estimated separate linear regression models using SAS 9.1 Statistical Software to see how individual HIV knowledge is influenced by individual and community demographic variables.

The Dependent variable (Y) of interest is a binary index variable measuring a woman's HIV/AIDS Knowledge and is based on a battery of five survey questions asked in the DHS surveys in each of the 21 sampled countries and includes: whether the respondent

is aware of methods to prevent the risk of getting AIDS (through abstinence, by always using a condom during sex, and by having only one sexual partner) and whether she knows that it is not possible to get AIDS by sharing food with an infected person nor from mosquito bites. The index was constructed by summing the given answers to the survey questions (either correct or incorrect) and obtaining an indexed measure of HIV/AIDS knowledge between 0 and 5. Thus an individual who answered all questions incorrectly will achieve a score of zero and those who answered all correctly achieve five, indicating perfect knowledge. See Table 2 below for a distribution of the observed answers to the questions making up the index.

Table 5 Knowledge Distribution

Knowledge Distributi on				
Sumaids	Frequency	Percent	Cumulati ve Frequency	Cumulati ve Percent
0	6073	2,70 %	6073	2,70 %
1	8864	3,94 %	14937	6,65 %
2	24636	10,96 %	39573	17,61 %
3	49993	22,24 %	89566	39,85 %
4	62345	27,74 %	151911	67,58 %
5	72870	32,42 %	224781	100,00 %

Independent variables entered into the models include a woman's own basic socio-demographic characteristics; age at the time of interview, education level (between zero and twenty years of completed schooling), and an indicator of household wealth. Since the DHS does not have information about individual or household incomes or expenditures, a wealth index was created in order to reflect some measure of household resources. This is done by summing the number of positive answers to the following questions: whether any members of the household own a radio or a bicycle, whether the house has electricity, whether it has access to piped water or a flush toilet, and whether the floor is made of materials other than dirt.

Table 6 Wealth Distribution

Wealth Distribution				
Wealth Index	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	33970	15,69 %	33970	15,69 %
1	48318	22,32 %	82288	38,01 %
2	50751	23,45 %	133039	61,46 %
3	37938	17,53 %	170977	78,99 %
4	25160	11,62 %	196137	90,61 %
5	16612	7,67 %	212749	98,28 %
6	3713	1,72 %	216462	100,00 %

In addition, I have considered six community-level variables; The level of education and wealth for women in the immediate and greater regions were obtained by taking averages of individual observations over the sampled clusters and provinces respectively.

The two other community variables are whether the given cluster from which an individual is surveyed is urban and the proportion of women in the province who live in an urban cluster. These variables are included in some of the models as controls for structural and other factors which may influence education, wealth and knowledge. In other words, women who live (or have been raised in) urban areas may have different estimates from those in rural areas and so this should be taken into account when looking at the effects of education and wealth for HIV knowledge.

Initially I estimate models using the data for all 224 781 women surveyed across the 21 countries to determine the average effects of education and wealth in capturing variation in individual HIV knowledge. However, as explained earlier, the changes in HIV knowledge may in fact be more or less sensitive in response to adjustments in certain socioeconomic variables, depending on the woman's given level of education at the time of interview.

In order to test for this, I split the sample into two broad categories based on previous educational attainment and estimate separate models for two sub-groups of women; (i.)Those with three or less years of schooling and (ii.)Those with more than three years, to determine how incremental changes in individual and aggregate (cluster-level) education impact HIV knowledge in each of the groups respectively.

In order to further compare the differences in predicted HIV knowledge between better and poorly educated women, I segregate the sample into three more narrow education distributions using dummy variables to distinguish between them. I have specifically chosen education brackets so as to contrast between education level(s) where women are most likely to have the greatest response to an improvement in education.

Also, the significant correlation between education and HIV prevalence that is often reported in studies about HIV/AIDS suggests that the effects of education on individual knowledge may differ significantly between women in different countries[2]. I suspect at the outset that women in countries with high HIV prevalence may be more knowledgeable about HIV/AIDS than those in countries with lower prevalence figures. Therefore, as with education, I have spilt the sample into two groups (on the basis of HIV prevalence) and estimate separate models to examine the effects of individual and community level education for women in each group.

Again, in order to incorporate more detailed information about HIV prevalence, rather than just a high/low dichotomy, and to test whether the effects of individual education tend to vary with the HIV prevalence in the woman's country I include an 'interaction term' for education and country specific prevalence.

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[2] There are often inconsistent results between earlier studies across different low and middle-income countries; some evidence suggesting that it is the most educated who are at greatest risk of getting AIDS in developing country contexts, whilst others indicate that the risks are still disproportionately skewed towards the poor and less educated. Much appears to depend on various country specific conditions and other factors. Nevertheless, despite often conflicting signs, empirical results consistently indicate strong associations between education and HIV/AIDS prevalence.

I then estimate a model which includes this variable along with some other individual level variables to test if there is a statistical difference in the effect of education by prevalence.

4. RESULTS

Model 1 Basic Model HIV/AIDS Knowledge Index including Three Individual Explanatory Variables

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,10706	0,00961	323,16	<,0001
Age	1	0,00133	0,00028037	4,73	<,0001
Educati on in years	1	0,08466	0,00064573	131,1	<,0001
Individual-level wealth	1	0,05475	0,00185	29,65	<,0001

Model one show the results of modelling an individual woman's expected HIV Knowledge and includes her age, her level of education and a measure of her personal (or household) wealth. According to this model, as expected, all three variables are positively associated with the woman's HIV/AIDS knowledge; an additional year of education increases the knowledge indicator by 0.085, an additional unit of the wealth index increases it by 0.055, and the impact of one year higher age is 0.001. All these effects are highly significant. The estimates accord well with findings in similar earlier studies, for example those reported by Stephenson (2009.)

The subsequent models (two-eight) introduce aggregate variables and examine the influence of community-level factors in capturing variation in individual HIV knowledge.

In the next step (Model 2), the average level of education among women in the primary sample unit (cluster) was added. This factor has a significantly positive effect on individual reported knowledge, over and above that of the woman's own education level and the two other individual characteristics included. When the average educational level is increased by one year, the knowledge indicator is estimated to increase by 0.039. The effect of individual education is weaker with this model specification, as one would expect: indicating that women who themselves have high education tend to live in areas where there are relatively many educated women, and when the effect of the latter is controlled for, the individual-level effect is reduced.

Also the effect of the individual wealth index is weaker, and – more surprisingly – that of the woman's age. The latter is no longer significant at the 5% level.

Model 2 Basic Model including Aggregate Cluster Education

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,07936	0,00963	319,79	<,0001
Age	1	0,000361	0,000281	1,28	0,1998
Educati on in years	1	0,0657	0,000869	75,56	<,0001
Individual-level wealth	1	0,03838	0,00191	20,09	<,0001
Cluster Educati on	1	0,03947	0,00122	32,46	<,0001

In model 3 below, the average wealth in the cluster is included instead of the average education. This factor also has a significant positive effect on HIV/AIDS knowledge, and when this effect is taken into account, the effect of individual wealth is reduced.

Model 3 Basic Model including Aggregate Cluster Wealth

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,09179	0,00986	313,6	<,0001
Age	1	0,00129	0,00028	4,6	<,0001
Educati on in years	1	0,08395	0,000654	128,4	<,0001
Individual-level wealth	1	0,03872	0,00295	13,1	<,0001
Cluster Wealth	1	0,0252	0,00361	7,0	<,0001

The average education and the average wealth index are of course closely correlated, which means that when only one of them is included in the model, the effect captured by one of these reflects both the importance of that variable and the other (excluded) one. To separate the effects, we included both variables in model 4.

While there are still significant positive effects of individual education and wealth as well as average education, the community's average wealth has a significant *negative* effect on the woman's HIV/AIDS knowledge.

As discussed earlier, living in a relatively wealthy community may have two types of effects. One is that there may be better health and educational institutions, which may contribute to the spread of correct information about HIV/AIDS. Another is that, given a woman's own socioeconomic resources, living in a relatively rich community means that she has a poorer relative position. She may be more marginalized in such a society and thus not pick up information about this disease to the same extent as those with the same individual resources but who have a better relative standing. The adverse average wealth effect that is estimated here suggests that the latter mechanism dominates.

Model 4 Basic Model including Individual Variables & Aggregate Cluster Variables

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,09019	0,00984	314,17	<,0001
Age	1	0,000328	0,000281	1,16	0,244
Educati on in years	1	0,06504	0,000878	74,06	<,0001
Individual-level wealth	1	0,0506	0,00296	17,08	<,0001
Cluster Educati on	1	0,04208	0,00131	32,15	<,0001
Cluster Wealth	1	-0,0209	0,00387	-5,39	<,0001

As explained earlier, it is by no means obvious what the most relevant level of aggregation would be in such an analysis. Some of the relevant processes are played out at a low level (e.g. learning directly from others through conversation), others at a higher level (e.g. the quality of institutions being dependent on the socioeconomic resources in a larger area than the neighbourhood). The next step is therefore to consider province-level averages rather than cluster-level averages (before including both in a final step.)

First, the average education in the province is added (Model 5.) It has less impact on the woman's HIV/AIDS knowledge than the corresponding cluster average, indicating that the lower-level processes matter most. Consequently, the effect of the woman's own education is also less reduced than when the cluster average was added.

Model 5 Basic Model including Individual Variables & Average Province Education

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,08244	0,00992	310,84	<,0001
Age	1	0,00107	0,000281	3,81	0,0001
Educati on in years	1	0,08049	0,000766	105,1	<,0001
Individual-level wealth	1	0,05408	0,00185	29,27	<,0001
Average Educati on in Province	1	0,01211	0,0012	10,10	<,0001

The average wealth in the province, included in Model 6 instead of the average education, is *inversely* related to the HIV/AIDS knowledge index. Since this effect also reflects the advantage of living in a province where the educational level is generally high (due to the positive correlation between education and wealth), the estimate suggests that the pure effect of average wealth at this level of aggregation is very sharply negative. This is confirmed in Model 7, where both province-level factors are included.

The bottom line is that a high average education in the province enhances the woman's knowledge about HIV/AIDS, while there is a very clear opposite effect of a high average wealth in the province. In other words, the signs of the effects are just as for the corresponding cluster-level effects (Model 4.) The stronger adverse effect of average wealth at the province than at the cluster level is not easy to understand. To the extent that the argument about relative wealth and marginalization is relevant, it seems that the position in the hierarchy in the province matters more than the corresponding relative position at the lower level. In principle, it is also possible that the potential opposing effect appears stronger when considering lower-level variables. More precisely, the quality of health and educational institutions, which may influence an individual's knowledge about HIV/AIDS, may depend more on the resources in the cluster than in the province. This does not sound very reasonable, though.

Model 6 Basic Model including individual Variables & Average Province Wealth

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,19373	0,01061	301,01	<,0001
Age	1	0,00148	0,00028	5,28	<,0001
Educati on in years	1	0,08585	0,000648	132,45	<,0001
Individual-level wealth	1	0,07438	0,00211	35,28	<,0001
Average Wealth in Province	1	-0,06646	0,00345	-19,24	<,0001

Model 7 Basic Model including Individual Variables & Province Average Variables

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,1895	0,0106	300,94	<,0001
Age	1	0,000921	0,000281	3,28	0,0010
Educati on in years	1	0,07569	0,000783	96,62	<,0001
Individual-level wealth	1	0,08634	0,00217	39,81	<,0001
Average Wealth in Province	1	-0,11297	0,004	-28,26	<,0001
Average Educati on in Province	2	0,0319	0,00139	23,02	<,0001

Finally, average education and wealth at both the cluster and the province level were included. There is of course a correlation across these levels: those who, for example, live in a province where the average education is high, also tend to live in clusters where the average education is high, and vice versa. It turns out that the positive effect of high average education in the province (that appeared with Model 7) disappears when we take into account that the woman also is exposed to a high overall educational level in her more immediate neighbourhood in this case. Stated differently, a high average education in the neighbourhood is important, but not the education in the remaining parts of the province. This would be consistent with an idea that learning through direct communication is a key mechanism. Turning to the wealth averages, a positive effect is found at the cluster level, while a negative effect is found at the province level. Assuming again that the involved mechanisms are the quality of institutions and the relative standing, it seems that the former effect (positive) is most relevant at the lowest level while the latter (negative) is most relevant at the highest level. The opposite would perhaps have seemed more reasonable.

Model 8 Final Model including Individual Variables, Cluster, and Province Variables

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,19297	0,01059	301,64	<,0001
Age	1	0,00046845	0,000281	1,67	0,0954
Educati on in years	1	0,06504	0,000877	74,17	<,0001
Individual-level wealth	1	0,05054	0,00296	17,08	<,0001
Cluster Educati on	1	0,04319	0,00203	21,23	<,0001
Cluster Wealth	1	0,02522	0,00487	5,18	<,0001
Average Educati on in Province	1	-0,00008319	0,00217	-0,04	0,9694
Average Wealth in Province	1	-0,10073	0,0051	-19,77	<,0001

A factor not considered above is that clusters with high average educational or wealth levels tend to be urban. Similarly, provinces with high average education or wealth tend to include many urban areas. It therefore makes sense to add two variables: whether the cluster is urban and the proportion of the women in the province who live in an urban cluster. This is done in Model 9.

Most importantly, inclusion of the urbanization variables wipes out the positive effect of the average wealth in the cluster, so that we are left with only a positive effect of the average education in the cluster and an adverse effect of a high level of wealth in the province (found initially.) In other words, what was suggested to be a benefit of high-quality institutions in better-off local areas may instead be explained by the fact that these areas tend to be urban and that knowledge may diffuse more rapidly where the population concentration is high. The adverse effect of urbanization in other parts of the province is perhaps yet another manifestation of the importance of relative position. For example, a rural cluster with a certain average level of education and wealth is perhaps more backward if the province otherwise is highly urbanized than if it is not.

Model 9 Final Model Controlling for Urbanisation

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3.18461	0.01078	295,35	<.0001
Age	1	0.00049834	.00028101	1,77	0.0762
Educati on in years	1	0.06501	.00087659	74,16	<.0001
Individual-level wealth	1	0.05045	0.00296	17,06	<.0001
Cluster Educati on	1	0.03944	0.00206	19,12	<.0001
Cluster Wealth	1	0.00685	0.00516	1,33	0.1839
Average Educati on in Province	1	0.00411	0.00220	1,87	0.0616
Average Wealth in Province	1	-0.07584	0.00654	-11,59	<.0001
Cluster Urban	1	0.08410	0.00781	10,77	<.0001
Province Urban	1	-0.11097	0.01896	-5,85	<.0001

Given the consistently significant positive effects of individual and cluster-level education for HIV knowledge in the models presented above, the models in the table below (model 10) now present the results of modelling individual expected knowledge *separately* for two sub-populations: Women with three or less years of education (model (ii.)) and Those with more than three years (model (iii.)), where each includes the woman's age, individual education and aggregate cluster level education variable.

Model 10 Models comparing Education Sub-groups

i)

Enti re Sample					
Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,13348	0,00917	341,75	<,0001
Age	1	0,00020486	0,0002759	0,74	0,4578
Educati on in years	1	0,06826	0,0008405	81,22	<,0001
Cluster Educati on	1	0,04497	0,001114	39,28	<,0001

ii)

<3 years Educati on					
Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	2,976	0,01432	207,86	<,0001
Age	1	0,0003609	0,0004373	0,83	0,4092
Educati on in years	1	0,08538	0,00473	18,04	<,0001
Cluster Educati on	1	0,09828	0,00201	48,81	<,0001

iii)

>3 years Educati on					
Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,42782	0,01301	263,43	<,0001
Age	1	0,00155	0,0003508	4,41	<,0001
Educati on in years	1	0,06259	0,0012	52,01	<,0001
Cluster Educati on	1	0,00467	0,00132	3,52	0,0004

In keeping with expectations, the results replicate the general positive association trend between individual and cluster average education and HIV knowledge for both low and better educated women. However, the effects of cluster education are now no longer significant for the latter group at the 5% level.

Also not surprisingly, comparing the results estimated for each of the two sub-groups reveals that there is a significantly steeper improvement in knowledge for each additional year of education undertaken for those who themselves have little or no education (versus the better educated group.) Each additional year of education increases the knowledge indicator by 0.086 and 0.063 for the less and better educated groups respectively.

This steeper education/knowledge gradient for the less educated indicates that, net of all other factors, an additional increase in education by one year, above the woman's current level, will yield the most significant improvement in HIV knowledge for those at the lower end of the education distribution. As discussed before, this difference in additional knowledge gained in response to incremental improvements in education implies that through the essential literacy and other basic skills acquired in the founding years of schooling, poorly educated women are likely to experience sharp improvements in HIV knowledge by gaining important factual information about HIV/AIDS for every extra year of formal education obtained. However, for those who already have some years of schooling; an additional year of education will help to improve her knowledge by building on to an already established level of knowledge acquired previously, thus indicating a flatter slope for this group.

The same is true for increased aggregate education of other women in the cluster as indicated by the coefficient for the cluster education parameter in model (ii.) Uneducated women are predicted to pick up proportionately more information about HIV/AIDS if the education in society is increased on average by an additional year, relative to the effects for those who themselves are more educated (for whom cluster education is shown to be insignificant.) This reinforces the argument presented before that less educated women may tend to be more dependent on the education (and/or resources) held by others around them as a source of accurate information about HIV than those who have attended school for some years.

In the 'benchmark' (Model (i.)) which considers all individuals in the sample, the effect of the woman's age was not considered to be of statistical importance in determining knowledge (at the 5% level tested.) But, once the data is stratified by level of education, the effects of a woman's age is now predicted to have a significant effect in explaining variation in individual HIV knowledge for women in the better educated group (model (iii.)) The significantly positive (albeit small) parameter estimate for age (0.000155) indicates that, holding all other factors constant, better educated older women are likely

to be more knowledgeable about HIV than their younger educated counterparts. This may indicate that by having more life experience and longer sexual lives, coupled with factual knowledge gained in school, older more educated women have better awareness than the younger educated. Older women may also have experienced greater exposure to the dangers of HIV/AIDS for longer periods by having lived through different periods of the epidemic.

In the proceeding model (model 11) I have further segregated the sample into three education categories; (i.) Women who have no or very marginal levels of education (two or less years), (ii.) those who have at least been exposed to enough years of formal schooling to have presumably learnt to read and write (between three and four years), and (iii.) those with better/completed primary schooling (five to seven years.) Education dummy variables are now used (in place of the continuous education variable) where the reference (base) category is two or less years of education ("education dummy 1".) This category is obviously omitted from the regression to avoid perfect multicollinearity. "Education dummy 2" is a dummy variable that takes on value 1 if the respondent has between three and four years of education, "Education dummy 3" takes on 1 if the respondent has between five and seven years of education. The coefficients on each of the education variables should now be interpreted as *differences* in the average HIV knowledge of women in that specific education category versus those who have less than two years of education (reference category.)

Model 11 Model Comparing Education Levels using dummy variables

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,09547	0,00936	330,61	<,0001
Age	1	0,0009321	0,00027848	3,35	0,0008
Educati on Dummy 2	1	0,43674	0,00721	60,56	<,0001
Educati on Dummy 3	1	0,65733	0,00871	75,47	<,0001
Cluster Educati on	1	0,05281	0,0011	47,96	<,0001

From the results in model 11 we see that the education dummies are highly significant at the 5% level indicating there is a statistical difference between the average knowledge of women in each of the education categories (ie. the difference in average knowledge in the three groups is significantly different from zero.) In other words, this model further confirms the previous results presented before which find that the effects of additional education taper off with increased levels. Specifically, there is clear evidence that, on average, better educated women (with more than two years of education) are likely to be substantially more knowledgeable about HIV prevention and transmission than poorly educated women (less than two years) in the base/reference category.

The magnitude of these differences are large and indicate that the average knowledge level of women who have between three and four years of education is 0.44 larger in comparison with those with less than two years. Similarly, women in the sample who have between five and seven years of will have an improvement of 0.66 in their knowledge index than poorly educated women with less than two years and 0.22(0.66-0.44) better than women who have between three and four years.

Although women who have attended more than four years of primary school clearly have more extensive knowledge (on average) in comparison to all those with less than four years, as would be expected, still the greatest difference is between those with very low (or no) education and those who are at least literate. This may have important implications for policies which aim to improve HIV knowledge through formal education expansion for women and girls. By merely enabling women to read and write, such policies are likely to yield significant improvements in what these women know about the disease.

Table 7 HIV/AIDS Country Prevalence

HIV/AIDS COUNTRY PREVALENCE			
	Women 15-49	Men 15-49	Total 15-49
Benin 2006	1,5 %	0,8 %	1,2 %
Cameroon 2004	6,8 %	4,1 %	5,5 %
Cote d'Ivoire 2005	6,4 %	2,9 %	4,7 %
Ethiopia 2005	1,9 %	0,9 %	1,4 %
Ghana 2003	2,7 %	1,5 %	2,2 %
Guinea 2005	1,9 %	0,9 %	1,5 %
Kenya 2003	8,7 %	4,6 %	6,7 %
Malawi 2004	13,3 %	10,2 %	11,8 %
Mali 2006	1,4 %	0,9 %	1,2 %
Niger 2006	0,7 %	0,7 %	0,7 %
Rwanda 2005	3,6 %	2,3 %	3,0 %
Senegal 2005	0,9 %	0,4 %	0,7 %
Tanzania 2007-08	6,6 %	4,6 %	5,7 %
Uganda 2004-05	7,5 %	5,0 %	6,4 %
Zambia 2007	16,1 %	12,3 %	14,3 %
Zimbabwe 2005-06	21,1 %	14,5 %	18,1 %

3

The models below now allow for comparisons between the different effects of an increase in education for women who live in countries with different reported HIV prevalence.

[3] Country-specific HIV prevalence Rates for countries included in the sample where data available (Taken from the DHS website, 2011)

Model 12 Prevalence Comparisons

i)

Entire Sample					
Variable	DF	Parameter Estimate	Standard Error	t-value	Pr > |t|
Intercept	1	3,13348	0,00917	341,75	<,0001
Age	1	0,000205	0,000276	0,74	0,4578
Education in years	1	0,06826	0,000841	81,22	<,0001
Cluster Education	1	0,04497	0,001114	39,28	<,0001

ii)

< 10% HIV/AIDS Prevalence					
Variable	DF	Parameter Estimate	Standard Error	t-value	Pr > |t|
Intercept	1	3,01337	0,01513	199,15	<,0001
Age	1	-0,00227	0,000456	-4,98	<,0001
Education in years	1	0,08578	0,00137	62,54	<,0001
Cluster Education	1	0,05775	0,00191	30,17	<,0001

iii)

> 10% HIV/AIDS Prevalence					
Variable	DF	Parameter Estimate	Standard Error	t-value	Pr > |t|
Intercept	1	3,16183	0,02816	112,29	<,0001
Age	1	0,00376	0,000732	5,13	<,0001
Education in years	1	0,06196	0,0024	25,82	<,0001
Cluster Education	1	0,03596	0,00356	10,1	<,0001

The models above were estimated separately for women who live in: countries where the reported national average prevalence rate is lower than 10% (model (ii.)) and those

from countries with HIV levels higher than 10% prevalence[4](model (iii.)) and includes the same variables as in the regressions shown in Model 11.

Again, the results are in line with what was expected at the outset; net of other factors, women who live in countries with *lower* reported national HIV prevalence rates are predicted to have *stronger* improvements in HIV knowledge for a given one year increase in their own education levels than those in countries with prevalence figures in excess of 10%. This I attribute to the relative importance of formal education and literacy in providing better knowledge about HIV in countries where the disease is relatively less widespread and perhaps somewhat unknown.

Model (ii.) above shows that those who live in countries where there is a *high* prevalence exhibit a less noteworthy improvement in knowledge for each additional year of individual education, as expected. Clearly this is because women who live in countries where the prevalence rate is high are likely to have been exposed to the consequences of HIV infection and prevention methods through exposure in other ways, such as knowing people who have been infected and through greater emphasis placed on widespread HIV information campaigns in these countries.

The same effects are seen for cluster level education: those in *low* prevalence countries appear to be *more* reliant on the formal education levels of others than those in countries with higher prevalence rates where women are exposed to the disease more frequently and therefore learn about HIV not only via formal sources but through other less formal channels too.

Again, as with segregating that data for different education levels, once we account for differences in prevalence rates in the respondent's country, age enters the models as a significant explanatory factor now for both those in low *and* high prevalence countries; a significant *negative* effect is felt for those in the former indicating that older women in countries with low prevalence know less than young women in these countries.

[4]Prevalence Data was taken from the DHS website

There are a number of plausible reasons for the above estimates. The results essentially indicate that young women appear to be better able to gain information about HIV from various informal sources in countries where there are less people infected. One reason for this may be because older women in countries that have not experienced generalized epidemics may not have been exposed to education campaigns introduced later in schools. Another possible explanation may be given that young sexually active people are generally considered to be most at risk of HIV/AIDS infection, messages and campaigns that are dispersed in countries with lower than 10% HIV levels may tend to be focused on targeting this younger group.

It may also be reflective of differences in cultural norms across generations for example. Younger women who have grown up in more modern (and possibly more mobile) societies where a woman's ability to work outside of the house is more accepted may have different opportunities for socialization with others whom she may learn about HIV/AIDS from, than older women. In such societies, it may also be more commonly accepted for young people to discuss subjects such as HIV and sex more openly.

One reason for the pronounced positive effects of age for women in high prevalence countries may be because of greater length of exposure to the disease. Given that a person is able to live with the HIV virus for many years undetected, perhaps older people are more exposed to the lethal consequences of AIDS at a later stage among older peers than young women.

To further examine whether (and to what extent) the effect on knowledge of a change in education may depend on the actual HIV prevalence rate in the woman's country, I have included an interaction term for individual education and HIV prevalence. For simplicity, I have only included this term in the first simple model at the beginning of this chapter (model one) and the results are shown in Model 13 below.

Model 13 Model including Education/HIV Interaction term

Variable	DF	Parameter Esti mate	Standard Error	t-value	Pr > |t|
Intercept	1	3,09845	0,01114	278,18	<,0001
Age	1	0,00152	0,00032623	4,66	<,0001
Educati on in years	1	0,10082	0,00101	99,62	<,0001
Individual-level wealth	1	0,05308	0,00208	25,46	<,0001
Interacti on Term	1	-0,0003997	0,00009455	-4,23	<,0001

.

The results indicate that for a woman living in a fictitious country with zero HIV prevalence, an increase in her own education by one year would improve her HIV knowledge index by 0.100082 (the coefficient for the education parameter.) However, as expected for reasons discussed previously, we again see that the effect of education weakens slightly as the HIV prevalence increases (indicated by the negative sign of the interaction parameter.) These differences are not large, though the interaction is statistically significant at the 5% level. By including this interaction, I allow for the effect on an individual woman's knowledge, due to an increase in education by one year, to depend on the HIV prevalence rate in the country she lives in. So, for example, in a country where the prevalence rate is 10% and the education parameter is as predicted above (0.10082), the effects of education now becomes 0.0997 (0.101+(10*(-0.0004)), while in a country where the prevalence is 15%, the effect is 0.0994(0.100082+(0.15*-0.0003997)), and so on.

5. SUMMARY AND CONCLUSION

I have analysed the effects of determinants of knowledge about HIV/AIDS prevention and transmission among women in rural and urban areas from 21 countries in sub-Saharan Africa. The results generated reveal the important influence of a woman's community environment in determining the extent of her knowledge about HIV/AIDS transmission, in addition to the effect of her own education and income.

I show that women who live in communities where other women have, on average, higher levels of education, are predicted to have significantly better knowledge about HIV/AIDS than those who do not live in such areas but who themselves have the same level of education.

These estimates serve to further complement those found in the only other study (that I am aware of) about factors which shape HIV knowledge using similar community aggregate socioeconomic variables by Stephenson (2009) where average female education had a positive effect on knowledge in *one* of the three sampled countries he studied. In this paper, I have analyzed data from a larger sample and consider two levels of aggregation; the census enumeration area and the province, for women from 21 countries. It should be noted that the findings here are also consistent with other previous studies which find that higher levels of community education are associated with greater levels of general health knowledge.

In this analysis, the most consistent and pronounced influence of higher community education for a woman's HIV knowledge, are the effects exerted by her immediate neighbourhood. Although the education of other women in the province in which she resides does also appear to indicate a (weaker) positive effect on a woman's HIV knowledge in some of the models, this effect disappears when also taking the average education in the cluster into account (in the final preferred model which includes all community-levels variables) and in a model which accounts for the degree of urbanization. These results may appear somewhat counter-intuitive, however they may be more easily understood when taking into account that the sexually transmitted nature

of HIV/AIDS renders itself more likely to be spoken about within intimate personal social networks. Women may be more comfortable discussing such topics with women from more or less the same backgrounds, where they have a greater degree of trust between one another and are able to observe the actions of others more directly at the neighbourhood level.

A more complex and potentially confusing pattern emerges when assessing the influence of community *wealth* levels for an individual woman's HIV/AIDS knowledge. However this is not necessarily all that surprising given the mixed effects of individual wealth often also reported in studies assessing HIV outcomes and prevention behaviours. I find that living in a relatively wealthy *province* is predicted to have strongly detrimental effects for a woman's knowledge, whereas the opposite is true for those who live in *neighbourhoods* where other woman have, on average, a high level of wealth. These effects found at the province-level of aggregation may reflect that, given the individual education and wealth, those who live in provinces with a high average wealth have a poorer relative standing than those living in other provinces. This may dominate any beneficial effect of the absolute wealth level among others, such as better health institutions. I have controlled for the fact that areas with educated and wealthy people tend to be urban. Living in an urban area has itself a potential effect, possibly because of people living in closer geographical proximity to one another. In such a situation they may benefit through direct learning from their neighbours.

Also, the effects of individual education is of some interest. In keeping with findings in other studies, the models estimated in this paper show that individual level education appears to play a key role in shaping HIV knowledge. I have estimated significant effects of this factor in all the models throughout this analysis.

Naturally, women who have completed (or at least have some years of) primary schooling were singled out as the group with the highest *level* of knowledge about HIV/AIDS in the sample. As would have been expected, these women have indicated having the most complex and broad awareness and understanding about HIV (by

correctly answering a higher proportion of the questions making up the knowledge index) than other women in the sample.

However, on closer inspection, the strongest effects of a marginal increase in education are felt for those who themselves have low levels of education. Therefore, through education expansion policies aimed at uneducated and illiterate women, by raising education levels by even only a few years for this group, one might expect uneducated women to have better HIV knowledge and hold less misconceptions about transmission.

The summary statistics presented earlier in this paper also indicate the need for such improvements. Given that nearly 40% of the women sampled reported having no years of formal schooling, it is not surprising therefore to see the low proportion (about 33%) of those who were able to answer all five simple questions correctly to ensure sufficient protection (see table 2.) So, above the need to expand education to improve knowledge, there is obviously also a need for more immediate measures to ensure that illiterate and poorly educated women are better able to access factual information AIDS that they can understand.

I have also reported important consequences for individual understanding of HIV in response to education improvements for women based on differences in the level of HIV infection in the different countries sampled. The most pronounced predicted knowledge response to adjustments in education are seen for women in countries where the prevalence figures are still relatively low. Although women in such countries may be protected to some extent from infection by living in countries where less people actually have the disease relative to those in places where many people are infected, their stronger dependence on information about HIV from formal schooling (than those in high prevalence countries) may be reason for some concern. It indicates that women in these countries who are not able to access some basic level of education may not know sufficiently to protect themselves.

Even though prevalence figures may be considered somewhat low (relative to others in the sample), given alarming indicators of poverty and high levels of illiteracy and factors such as cultures which accept multiple sexual partners in Sub-Saharan Africa, even African nations who have not yet experienced widespread AIDS epidemics may be extremely vulnerable to risk of rapid spread in future (Boerma, 2002.)

In general, African governments have been notoriously delayed in their response to addressing the disease and as pointed out by Glick et al. (2007), in countries where knowledge has appeared to improve over time, such as in Zambia and Uganda, this has come at the cost of much devastation by AIDS. Sufficient mobilisation campaigns have only been launched in *response* to epidemics.

Given all the results I have found for education and HIV knowledge, and the obvious link between knowledge and behaviour in the context of HIV/AIDS, it is not surprising to see results indicating deviations in sexual *behaviour* often differ between individuals with different socioeconomic indicators. For example, numerous empirical studies have found that although wealthy and/or more educated individuals often tend to have more non-regular sexual partners than less educated poorer people (see Blanc, 2000; Filmer, 1998; Hargreaves et al., 2002; and Hargreaves, et al., 2008), there is also a marked increase in condom use among the former group, largely attributed to the effects education has for sexual behaviour (see for example Gillespie, et al. 2007.)

There are of course several limitations to this study. Firstly, the data used only allows for us to check if certain factors have an effect (and the extent of this effect) on an individual woman's level of knowledge and therefore we can only speculate about the causal mechanisms outlined throughout. Secondly, because this analysis is limited to examining the effects on knowledge, we are not able to understand further, based on these results, whether better knowledge in this sample did in fact contributed to differences in sexual behaviours such as condom use and abstinence. In addition, as with all survey collections, the data depends on self-reported factors and knowledge and on those conducting the interviews and thus may be biased by untruthful reporting and

human errors. Finally it also needs to be kept in mind that although the questions are used to determine a given level of HIV knowledge, there is strong reason to believe (based on previous research, and as outlined before) that correct and incorrect beliefs do exist side-by-side and are largely independent of one another. As such, just because an individual is able to correctly answer all five questions used here, it does not necessarily mean that she does not hold other incorrect beliefs about HIV.

In summary, the findings here suggest that increased average levels of formal education and wealth are important for the diffusion of HIV knowledge among individuals. They also suggest an important role for social networks and of *place,* for shaping an individual's knowledge, though the effects offered by the level of aggregation in a way that is difficult to understand. Similar earlier studies have not discussed the importance of the level of aggregation. By having a better understanding of the mechanisms through which different factors act on HIV knowledge, information campaigns can hope to achieve improved behaviour modifications and target those who are most likely to have insufficient knowledge about AIDS.

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